



Assessment of yield and economic indicators in clusterbean grown in front-line demonstration under rainfed conditions in Jhunjhunu district of Rajasthan

Rashid Khan^{1#}, Dayanand¹, Subhash Chandra², Rajendra Nagar¹, Pradeep Kumar¹ and Devilal Jat¹

Summary

Clusterbean (*Cyamopsis tetragonoloba* L.), an important legume crop of arid and semi-arid regions, plays a vital role in sustaining the livelihoods of farmers in Rajasthan due to its drought tolerance, soil-enriching properties, and industrial applications. This study was undertaken to assess the yield potential and economic viability of an improved clusterbean variety, RGC-1033, compared to local farmer varieties under rainfed conditions in the Jhunjhunu district through Front Line Demonstrations (FLDs) during Kharif 2023 and 2024. The results revealed that RGC-1033 consistently outperformed the control varieties, recording an average yield of 17.68 quintal/ha compared to 15.01 quintal/ha under farmer practices, with yield increases of 17.57% and 18.12% in 2023 and 2024, respectively. The extension and technology gaps indicated the need for improved dissemination and adoption of recommended practices. Economically, the improved variety demonstrated higher profitability with a gross return of ₹98,450/ha and ₹78,350/ha, and a net return of ₹62,825/ha and ₹42,650/ha in 2023 and 2024, respectively, compared to lower returns from local varieties. The benefit-cost (B:C) ratio also improved under demonstration plots (2.76 and 2.19) over farmer practices (2.43 and 1.91). These findings underscore the significance of adopting improved clusterbean varieties and scientific practices to bridge the yield and technology gaps, thereby enhancing farmer income under rainfed agro-ecologies.

JAE 2025, Vol 21

Received: 18 September 2025

Accepted: 29 November 2025

Published: 20 December 2025

<https://doi.org/10.58628/JAE-2521-106>

Associated Editor: Dr. Kamlesh Kumar

Copyright © 2025 The Author(s). Published by Society for Agriculture and Arid Ecology Research (SAAER). This is an Open Access article under the Creative Commons Attribution License 4.0 (CC BY-NC-SA).



Keywords: Clusterbean, Front Line Demonstration, Rainfed Agriculture, Yield Gap, Economic Indicators

Introduction

Clusterbean (*Cyamopsis tetragonoloba* L.), commonly known as guar, is an important leguminous crop predominantly grown in arid and semi-arid regions of India. Rajasthan is the leading state in clusterbean cultivation, contributing over 80% of the national production owing to its adaptability to drought-prone regions, particularly under rainfed conditions. The crop serves multiple purposes: as a source of vegetable, green manure, fodder, and industrial raw material. After dehulling the seed, the gum is produced primarily from pulverized endosperm (Sabahelkheir et al. 2012). It has high calorific and nutritive value and its seed contains 28-32% of gum (Kherawat et al. 2013; Choudhary et al. 2021). Despite its importance, the average productivity of clusterbean at farmers' field remains considerably low compared to its potential. This yield gap is often attributed to the use of local or outdated varieties, poor adoption of improved agronomic practices, inadequate input management, and erratic rainfall patterns. The front-line demonstration (FLD) approach has proven effective in bridging this gap by disseminating the latest technologies and high-yielding varieties (HYVs) directly to the farmers, thereby improving yield

Jhunjhunu district of Rajasthan, falling within the transitional zone between arid and semi-arid climates, experiences frequent droughts and erratic rainfall, making the cultivation of drought-tolerant crops like clusterbean essential for sustainable farming. Through FLDs, improved clusterbean varieties such as RGC-1033 have shown promise in enhancing productivity and profitability under rainfed conditions by introducing better plant types, disease resistance, and improved gum quality. The present study was conducted to assess the yield performance and economic viability of improved clusterbean variety RGC-1033 in comparison to the local varieties traditionally cultivated by farmers under rainfed conditions in Jhunjhunu district during the Kharif seasons of 2023 and 2024. Specific indicators such as yield increase, extension and technology gaps, cost-benefit ratios, and net returns were analyzed to evaluate the impact of FLDs. These findings are crucial for formulating extension strategies and policy interventions aimed at enhancing the livelihoods of dry land farmers in the region.

Materials and Methods

The present study was conducted in the Jhunjhunu district of Rajasthan, a semi-arid region situated in the agro-climatic zone II (Transitional Plain of Inland Drainage Zone) of the state. The area receives an average annual rainfall of approximately 400–500 mm, primarily during the monsoon season (July–

¹Krishi Vigyan Kendra, Abusar Jhunjhunu, Rajasthan, India

²Ex Director Extension, SKRAU Bikaner, Rajasthan, India

[#]Corresponding author: Rashid Khan E-mail: rsdptn7@gmail.com performance and economic returns under real-world conditions.

September). The soils of the region are generally sandy loam to loamy sand in texture with low water holding capacity and poor organic carbon content.

The study was carried out under Front Line Demonstrations (FLDs) conducted over two consecutive Kharif seasons: Kharif- 2023 and Kharif-2024. The demonstrations were implemented on farmers' fields to assess the performance of improved clusterbean variety RGC-1033 in comparison to local/farmers' practices. A total of 50 demonstrations were laid out during the study period, involving 25 demonstrations in each year. In this study, two treatments were compared:

1. Improved Practice (Demonstration plots): Cultivation of clusterbean variety RGC-1033 using recommended agronomic practices.
2. Farmers' Practice (Control plots): Cultivation using local varieties and traditional farmer methods.

Varietal and Agronomic Details are:

- Improved variety: RGC-1033, a high-yielding and drought-tolerant variety recommended for arid and semi-arid regions.
- Potential yield: 22.79 quintals/ha
- Seed rate: 15 kg/ha.
- Sowing time: June- July
- Spacing: 45 cm × 10 cm.
- Fertilizer application: 20 kg N + 40 kg P2O5/ha as basal dose.
- Weed and pest management: As per package of practices recommended for zone.

Each demonstration was laid out on 0.4 ha land.

Regular monitoring and field visits were conducted by scientists and subject matter specialists from the Krishi Vigyan Kendra (KVK), ensuring timely input delivery and farmer guidance. Field days, group discussions, and training sessions were organized to enhance farmer awareness and participation. Data were collected on the various parameters viz., Grain yield (q/ha), technology performance parameters; Technology gap, Extension gap and Technology index and economic parameters; Cost of cultivation (Rs./ha) including seed, fertilizer, plant protection, labor, etc., Gross and net returns (Rs./ha) calculated using the market price of Rs. 5000/q, Benefit-cost (B:C) ratio. Descriptive statistics such as mean, percentage increase, and benefit-cost ratio were calculated. The effectiveness of the improved technology was analyzed using standard economic and extension indicators as per methodologies suggested by Samui et al. (2000) and Ramniwas et al. (2022a&b).

Result and Discussion

The yield assessment of clusterbean under frontline demonstrations (FLDs) was conducted for two consecutive kharif seasons (2023 and 2024) in the rainfed agro-ecosystem of Jhunjhunu district, Rajasthan. Two varieties were evaluated: the improved variety RGC-1033 and the local farmer's variety. The performance data clearly indicated a consistent yield advantage of RGC-1033 under demonstration plots over the traditional practices adopted by farmers.

Yield Comparison and Performance

In 2023, the mean yield of the improved variety under FLDs was 19.69 quintals per hectare, whereas the yield under farmer practice was 16.75 q/ha, marking a 17.57% increase. Similarly, in 2024, the demonstration plots yielded 15.67 q/ha, compared to 13.27 q/ha under farmer practice, reflecting an 18.12% increase in yield. On average across both years, FLD plots yielded 17.68 q/ha, as compared to 15.01 q/ha from traditional practices, indicating a 17.80% overall improvement (Table 1). This outcome is consistent with Jain et al. (2019) and Verma et al. (2015) findings. These findings validate the effectiveness of improved technology packages, including certified seeds, proper spacing, timely sowing, and nutrient and weed management. Frontline demonstrations are vital for showcasing the potential of improved varieties and reducing the yield gap between research and farmer fields.

Yield Gaps and Technological Index

The extension gap, which highlights the difference in yield between demonstration and farmer practices, was 2.94 q/ha in 2023 and 2.40 q/ha in 2024, with an average of 2.67 q/ha. This persistent gap suggests that improved yield levels can be achieved by wider dissemination and adoption of recommended practices among farmers. The technology gap, representing the difference between the potential yield of the crop (22.79 q/ha for RGC-1033) and the actual yield in demonstration plots, was 3.10 q/ha in 2023 and 7.12 q/ha in 2024. The higher gap in 2024 reflects the influence of adverse climatic conditions such as erratic rainfall or longer dry spells, which commonly impact yield in arid and semi-arid zones. These observations are supported by Jain (2016) and Narolia et al. (2015), who emphasized that despite technological advancements, environmental factors play a critical role in rainfed crop performance. Correspondingly, the technology index, which quantifies the feasibility of the demonstrated technology, was 13.60% in 2023 and 31.24% in 2024, averaging 22.42%. A lower technology index denotes better suitability and adoption potential of the variety in a specific region. The notable increase in the technology index during 2024 implies lower efficiency under less favourable conditions, echoing findings by Dhaka et al. (2015), Jain (2018) and Singh et al. (2014), who reported similar fluctuations in the yield performance of pulses and legumes in rainfed FLDs due to climate variability. The year-on-year variation in yield suggests the high sensitivity of clusterbean to rainfall distribution and soil moisture. Even with improved technology, the lower yield in 2024 underlines the importance of integrating climate-resilient practices, such as in-situ moisture conservation, drought-tolerant varieties, and water harvesting interventions. An enhanced yield in arid legumes requires not only genetic improvement but also micro-climatic management tailored to agro-ecological conditions. The demonstrated yield improvement confirms that with the adoption of the improved clusterbean variety RGC-1033 and scientific crop management, the productivity under rainfed conditions in Rajasthan can be significantly enhanced.

The higher performance under demonstrations reflects the potential to bridge the yield gap and improve food, fodder, and income security for marginal farmers in arid zones. Economic evaluation is a crucial component of assessing the impact and scalability of improved agricultural technologies. The frontline demonstrations (FLDs) conducted on cluster bean (variety RGC-1033) over two kharif seasons (2023 and 2024) in the Jhunjhunu district of Rajasthan provided valuable insights into the profitability and financial viability of improved technologies under rainfed conditions.

Economic indicators

The cost of cultivation under demonstration plots was slightly higher compared to farmers' traditional practices due to the inclusion of improved inputs such as certified seed, recommended fertilization, and plant protection measures. The average cost over the two years was ₹35,662.50/ha in Demonstration plots while ₹34,569.50/ha in Farmers' practice. The approximately 3.16% increase in cost reflects the marginal additional investment required to implement improved agronomic practices. This is in line with observations by Jain (2017), who noted that improved technologies typically incur slightly higher costs initially but lead to substantially higher returns.

Despite the moderate increase in input costs, gross and net returns from demonstration plots were significantly higher due to improved yield performance. Based on a fixed market price of ₹5,000/quintal, the average yield-derived average gross returns were ₹88,400 from demonstration plot and ₹75,050 from the control plot,

while the average net return was ₹52,737.50 from demonstration plot and ₹40,480.50 from control plot. These figures clearly demonstrate that FLD plots generated, on average, 30.3% higher net returns than traditional practices, validating the economic superiority of the improved technology. These findings corroborate those of Jain *et al.* (2016), who documented that FLD programs for pulses and legumes often yield over 25–40% higher net returns, especially in rainfed zones with high yield variability.

The B:C ratio, a widely accepted indicator of economic efficiency, was consistently higher in demonstration plots across both years. Average B:C ratios were 2.48 and 2.17 for Demonstration plots and Farmer's practice, respectively. The superior B:C ratio in FLD plots reflects better input-use efficiency and greater profitability. A B:C ratio exceeding 2.0 in rainfed systems indicates highly favorable economics, especially when associated with climate-resilient crop varieties and practices. These results are further supported by Asiwal *et al.* (2014) in groundnut, Joshi *et al.* (2014) in wheat, who reported similar improvements in profitability and sustainability when improved production technologies were adopted in semi-arid regions of India. The substantial economic advantage realized through FLDs justifies greater investment in extension services and input support for smallholder farmers. Ensuring wider adoption of improved varieties like RGC-1033 can significantly enhance farm income and reduce vulnerability to climatic uncertainties.

Table 1. Yield performance and technological gaps in cluster bean Frontline demonstrations

Year	Number of demonstrations	Yield (quintal/ha)		Increase over control (%)	Extension gap (q/ha)	Technology gap (q/ha)	Technology index (%)
		Demonstration	Farmer practice				
2023	25	19.69	16.75	17.57	2.94	3.10	13.60
2024	25	15.67	13.27	18.12	2.40	7.12	31.24
Avg.	25	17.68	15.01	17.78	2.67	5.11	22.42

*Potential yield considered: 22.79 quintal/ha

Table 2. Economic performance of cluster bean Frontline demonstrations

Year	Cost of cultivation (Rs./ha)		Gross return (Rs./ha)		Net return (Rs./ha)		B:C ratio	
	Demonstration	Farmer practice	Demonstration	Farmer practice	Demonstration	Farmer practice	Demonstration	Farmer practice
2023	35625.00	34489.00	98450.00	83750.00	62825.00	49260.00	2.76	2.43
2024	35700.00	34650.00	78350.00	66350.00	42650.00	31700.00	2.19	1.91
Avg.	35662.50	34569.50	88400.00	75050.00	52737.50	40480.50	2.48	2.17

*Market rate: ₹5,000/q

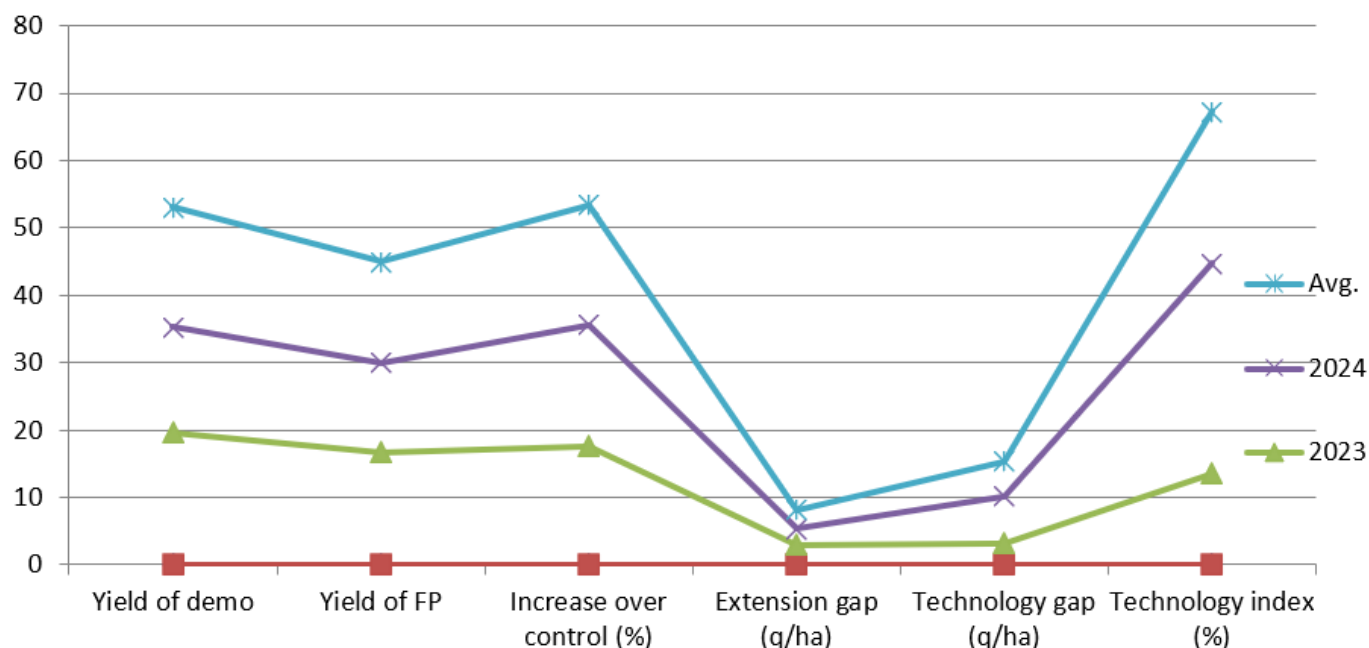


Figure 1. Yield performance and technological gaps in cluster bean Frontline demonstrations

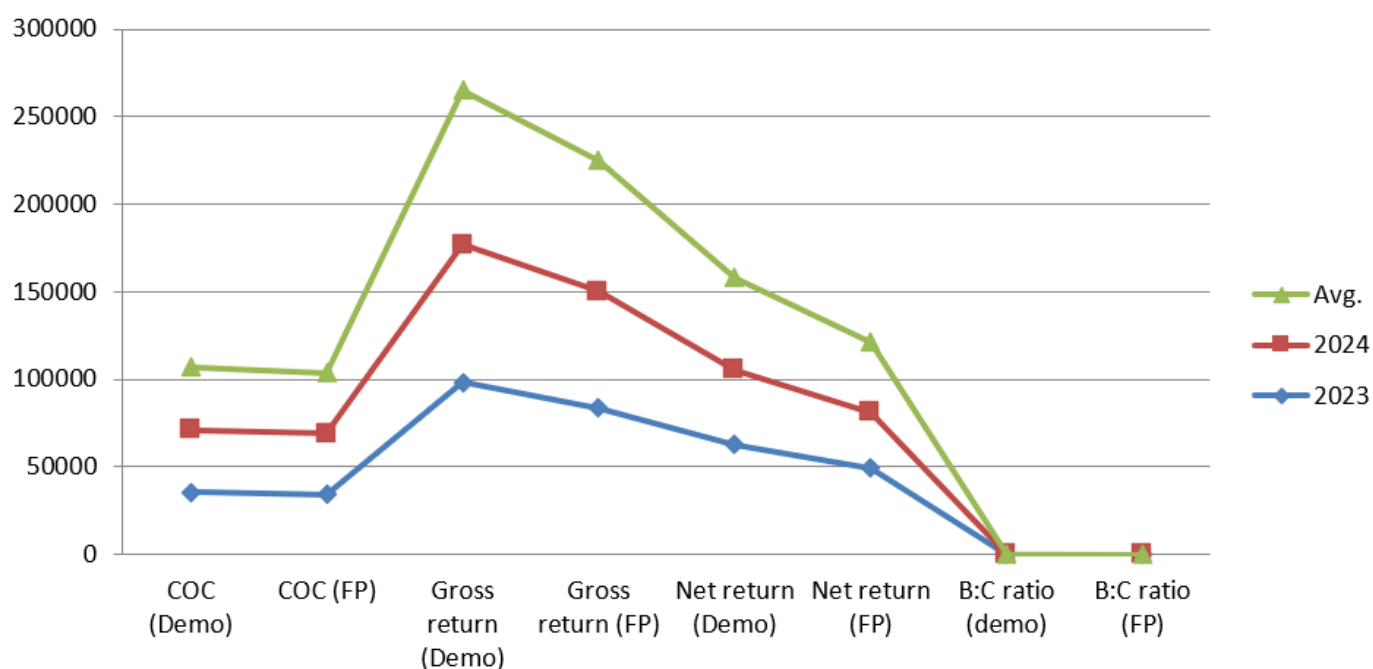


Figure 2. Economic performance of cluster bean Frontline demonstrations

References

1. Asiwal BL, Husain A, Akhter J & Ram L. 2014. Impact analysis of groundnut FLDs technology on extent of adoption, enhancing productivity and profitability in Sikar district of Rajasthan. *Agri update*, 9(4): 562-565.
2. Choudhary MK, Sharma R, Mahla HR, Singh D & Sarolia DK. 2021. Study the inheritance of branching behaviour and bearing pattern in clusterbean (*Cyamopsis tetragonoloba* (L.) Taub.). *Journal of Agriculture and Ecology*, 12: 94-97. <https://saaer.org.in/journals/index.php/jae/article/view/408>.
3. Dhaka BL, Bairwa RK & Ram B. 2016. Productivity and profitability analysis of blackgram (Cv. PU-31) at farmers' field. *J. Food Legumes*, 29: 71-73.
4. Jain LK, Parewa HP & Nandan B. 2017. Productivity and profitability analysis of clusterbean at farmers field in Barmer district in arid western arid zone of Rajasthan. *Journals of food legumes*, 31(2): 119-122.
5. Jain LK, Parewa HP & Ratnoo SD. 2019. Impact of frontline demonstration on productivity and profitability analysis of clusterbean in Barmer district of Rajasthan. *Forage Res.*, 44(4): 283- 286.
6. Jain LK. 2018. Technology and extension gaps in pearl millet productivity in Barmer district,

- Rajasthan. *Indian J. Dryland Agric. Res. & Dev.* 33: 39-42.
7. Joshi NS, Bariya MK & Kunjadia BB. 2014. Yield gap analysis through frontline demonstrations in wheat crop. *Inter. J. Sci. and Res.*, 4(9): 1-3.
 8. Kherawat BS, Lal M, Agarwal, M, Yadav HK & Kumar S. 2013. Effect of applied potassium and manganese on yield and uptake of nutrients by cluster bean (*Cyanosis tetragonoloba*). *Journal of Agricultural Physics*, 13(1): 22-26.
 9. Narolia RS, Meena H & Singh P. 2015. Impact of water management practices on productivity of soybean + maize intercropping system in Chambal command. *Ann. Agric. Res. New Series* Vol. 36: 364-369.
 10. Ramniwas, Kanwat M & Jat SR. 2022a. Impact through a front-line demonstration on yield and economics of fennel (*Foeniculum vulgare* Mill) in arid Kachchh of Gujarat. *Journal of Agriculture and Ecology*, 14: 125-130. <https://doi.org/10.58628/JAE-2214-217>.
 11. Ramniwas, Kanwat M & Jat SR. 2022b. Impact through frontline demonstrations on yield, yield gap and economics of drumstick farming in arid Kachchh of Gujarat. *Journal of Agriculture and Ecology*, 14: 135-140. <https://doi.org/10.58628/JAE-2214-219>.
 12. Sabahelkheir MK, Abdalla AH & Nouri SH. 2012. Quality assessment of guar gum (endosperm) of guar (*Cyamopsis tetragonoloba*). *ISCA Journal of Biological Sciences* 1(1): 67-70.
 13. Singh KM, Verma SK, Prasad N & Singh LB. 2014. Frontline Demonstrations (FLD): A bridge of Communication on Knowledge and Productivity enhancement of Blackgram (Urdbeen) in Shahjahanpur district of U.P. *The J. Rural and Agric. Res.* 14: 63-65.
 14. Verma RK, Dayanand, Rathore, RS, Mehta SM & Singh M. 2014. Yield and gap analysis of wheat productivity through frontline demonstrations in Jhunjhunu district of Rajasthan. *Ann. Agric. Res. New Series* Vol. 35: 79-82.